MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIAUNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, SESSION 2018/2019

EEL4116 – POWER STATIONS

(LE)

18 OCTOBER 2018
02:30 PM – 04:30 PM
(2 Hours)

INSTRUCTION TO STUDENT

1. This Question Paper consists of 4 pages with 5 Questions only.

2. Answer **ALL** questions. All questions carry equal marks and thedistribution of marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) A power station has a connected load of 45 MW and a maximum demand of 20.25 MW. The total annual energy generated by the station is 6132 x 10^4 kWh (Units). Consider a maximum demand of 20250 kW for the station, calculate

i) the demand factor [1 mark]
ii) the average power supplied [1 mark]
iii) the annual load factor [1 mark]
iv) the connected load factor. [1 mark]

(b) Define load factor, average power, and capacity factor, and write their equations. Explain the case when the load factor and the capacity factor can be numerically equal. [8 marks]

(c) A generating station is to supply four region of load whose peak loads are 10 MW, 5 MW, 8 MW, and 7 MW. The diversity factor at the station is 1.5 and the average annual load factor is 60%.

i) calculate the maximum demand on the station [2 marks]
ii) calculate annual energy supplied by the station [2 marks]
iii) suggest the installed capacity and choose the number of units. [4 marks]

Question 2

(a) Figure Q2a shows a schematic diagram of a Steam power plant, with all items labelled. Explain the whole steam generating process based on Rankine cycles, and the duty of each components. [10 marks]

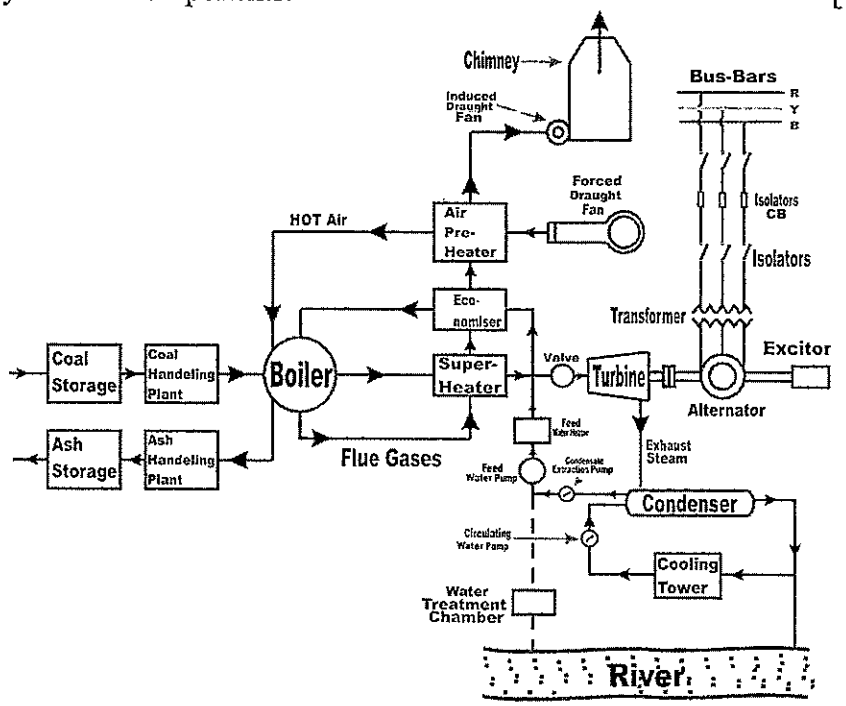

Figure Q2a

(b) A coal-fired power plant has a turbine generator rated at 1000 MW gross. The plant requires 9% of this power for its internal operations. It uses 9800 tons of coal of heating value 26 MJ/kg per day. Calculate the gross and net station efficiencies. [5 marks]

(c) For a consumer which has the following load-schedule for a day:
From midnight (12 am) to 6 am = 200 W
From 6 am to 12 noon = 3000 W
From 12 noon to 1 pm= 2000 W
From 1 pm to 4 pm = 4000 W
From 4 pm to 9 pm = 3000 W
From 9 pm to midnight = 1000 W.
Calculate:
i) the total energy consumed [3 marks]
ii) the load factor [2 marks]

Question 3

(a) A thermal power plant generates 450 MW. The power plant uses coal-fired for its boiler and it requires 8% of the output power for its internal operations. It uses 4500 tons of coal of heating value 26 MJ/kg per day. Calculate the gross and net station efficiencies. [5 marks]

(b) Draw a Double Bus Single Breaker scheme and explain its operation. [7 marks]

(c) A steam plant and a hydro plant are supplying a constant load of 90 MW for one day (24 h). The steam plant cost is expressed as:
$F(P_s) = 0.0213P_s^2 + 11.27P_s + 53.25$
where P_s is in MW and F is the cost in RM. Let the hydro plant be limited to 1,500 MWh of energy.
i) calculate the energy generated by steam power plant [4 marks]
ii) design optimal hydrothermal scheduling. [4 marks]

Continues...

Question 4

(a) Explain, with a neat schematic diagram, the operation of a combined cycle gas turbine power plant. [12 marks]

(b) Discuss the environmental effect of coal-fired thermal power stations. [3 marks]

(c) How much will be the monthly and average electric charges in RM for a consumer with the tariff rates of Table Q4c for usage of 1728 kWh? [5 marks]

Table Q4c

For first 200 kWh	RM 0.218
For next 300 kWh	RM 0.258
For next 300 kWh	RM 0.278
For next 300 kWh	RM 0.318
For next 300 kWh	RM 0.335
For next 300 kWh	RM 0.355
For next 300 kWh	RM 0.405

Question 5

(a) Sketch a one-line diagram of a well-protected substation transformer with connected circuit breakers and relays, and explain the functions of each protection component. [10 marks]

(b) An industry consumes annually 4×10^6 kWh with a maximum demand of 1000 kW at 0.8 pf lagging.

i) Calculate its load factor [2 marks]

ii) Calculate the annual bill if the tariff rate is as follows: [3 marks]
Maximum demand charge = RM 5 per kVA per month
Energy charge = RM 0.35 per kWh

iii) Design a suitable reactive power compensating device to improve the power factor of the load to unity. Assume no change in the maximum power demand. [2 marks]

iv) Calculate the annual bill after the addition of the suitable reactive power compensating device. [3 marks]

End of paper.